

The IBM SELECTRIC Composer

The Evolution of Composition Technology†

Abstract: In this paper a discussion is presented on how the IBM SELECTRIC Composer fits into the evolution of composition technology—from the calligraphers of the Middle Ages to the modern photocomposers. The advantages and limitations of the machine are discussed briefly with emphasis being placed on their meaning for the typographer.

Introduction

The return of simplicity to composition through the use of the IBM SELECTRIC Composer is a significant new development in the evolution of composition technology. The future of this method of composition is based on simplifying the composition process.

While the IBM SELECTRIC Composer was still in development the Univers‡ type font was adapted to the machine in various point sizes and weights. A discussion of typographic quality will relate the Univers and other type fonts to the IBM SELECTRIC Composer.

Evolution of composition technology

The evolution of composition technology can best be described with the aid of a graphic illustration. With reference to Fig. 1a, we observe that the calligrapher of the Middle Ages wrote his books with a quill or pen. Expressing one's thoughts through one's own written word is the most direct means of communication other than the spoken word. Thus, the authors of the Middle Ages made their own books.

The need for thought diffusion prompted the invention of wood engraving by writers in the Middle Ages. Figure 1b illustrates the process of wood engraving and printing on a hand press. The volume and dissemination of the written word was thus increased, but the author could no longer produce his book alone—he had to engage the services of an engraver and a printer.

Figure 1c illustrates how the printing process was further complicated by the innovations of movable engravings, foundry type, composing, paging, and printing. These addi-

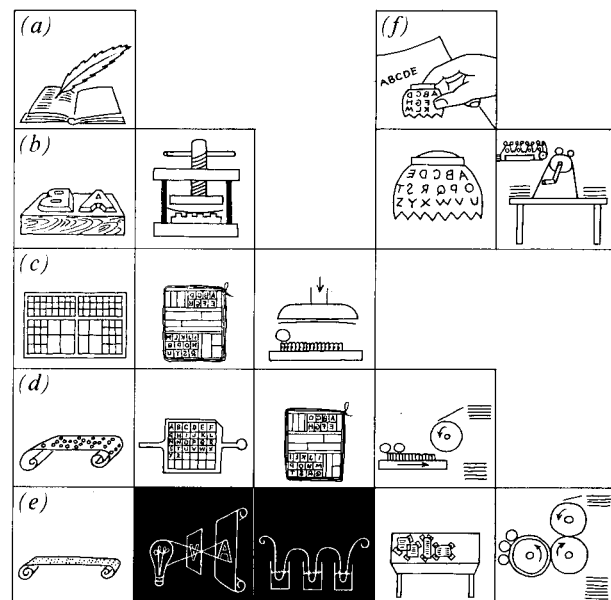


Figure 1 The evolution of composition: (a) handwriting; (b) wood engraving and hand press; (c) movable type and flat press; (d) modern hot-type composition and letterpress; (e) photo-composition and offset printing; (f) cold-type composition using the IBM SELECTRIC Composer.

tional steps between the author's written manuscript and the printed form introduced still more specialists and further removed the author from the preparation of his book. However, these innovations greatly increased the volume of printed material and any loss of typographic quality was more than justified.

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‡ *Univers* is the name given the sans serif type font first designed by the author for Deberny et Peignot Type Foundry, Paris, France.

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Next came mechanical and semi-automatic composing equipment, utilizing punched tape, foundry type, paging, and improved methods of printing, which again significantly increased the output of printed material. These innovations are graphically illustrated in Figure 1d.

Photocomposition also increases the output of printed material but, due to their complexity, these processes require many more specialists. The photocomposition process is illustrated in Figure 1e. Typographers, photographers, chemists or chemical process technicians, and press operators are all required to produce the printed page. Moreover, a significant part of the process is performed without any direct view of the composition—the compositor operates the equipment remotely and does not see the text he is composing.

It is evident through this evolution of composition technology that, as the rate of output and total output of printed material increased, the composition process became more complex, required more specialists, and removed the author further from the actual printing of his manuscript.

The IBM SELECTRIC Composer provides a new approach to the printing process in this evolution. Figure 1f illustrates the concept. With this machine the author can, if he chooses to do so, again write his own book without the assistance of specialists. The author could be referred to as a “modern calligrapher”—the Composer type element being the extension of his hand, so to speak, replacing the pen and also the art of writing. Composition, once again, becomes extremely simple and direct.

Typographic quality

In order to better understand the advantages and shortcomings of the various composition techniques just discussed, it is necessary to evaluate the typographic quality or aesthetic quality of the printed page. The left-hand column of Fig. 2 simulates the evolution of writing. What has been achieved in the parallel evolution of the printing process is depicted in the right-hand column. On the left, in Fig. 2a, is a present-day simulation of the hand printing of a calligrapher of the Middle Ages, shown on the right. In Fig. 2b a simulation of script handwriting is shown on the left, and on the right is a reproduction of the first writing set in foundry type, composed and printed in the Middle Ages. The appearance of the two forms is more and more differentiated; the script handwriting on the left shows a succession of characters tied together, while the printed form on the right shows a pattern produced by relief characters on lead blocks—all blocks having the same height, but the width of the blocks varying with each character. The type founder established a new width for every character. So it is still today.

On the left in Fig. 2c is shown a form of writing which, to some degree, has replaced handwriting—typewriter printing. Until some years ago the use of the typewriter as a

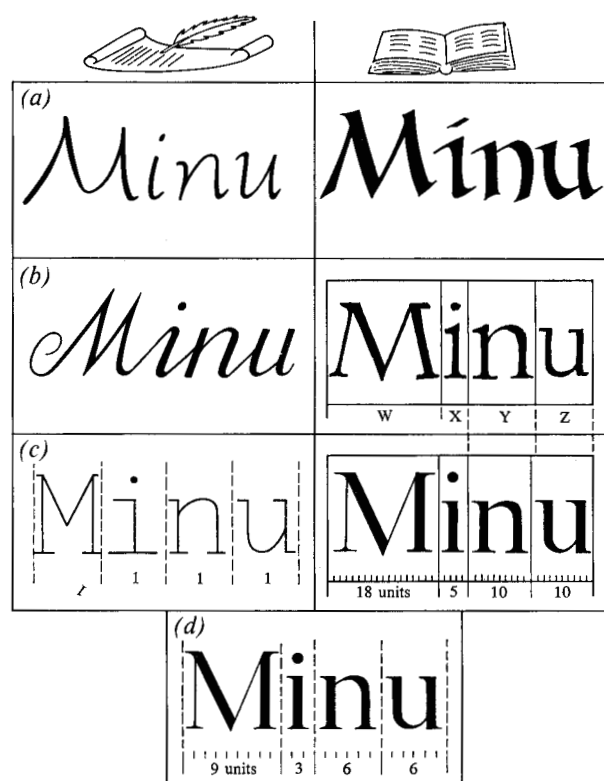


Figure 2 The evolution of character forms: (a) hand calligraphy; (b) script handwriting and early Foundry type; (c) fixed-width typewriter printing and proportional (modern) composition; (d) proportional (9-unit basis) type as used in the SELECTRIC Composer.

printing device was restricted because of its poor aesthetic quality. All the characters on the early typewriters were designed for the same width. Shown on the right, in Fig. 2c, is a printed sample produced by a present-day mechanical composing device. Letter widths are still restricted, since most manufacturers use an eighteen-unit system as a basis for the widest character. All characters have to be designed within that number of units and the type designer is no longer allowed the freedom he had in the days when wood engraving and foundry type were used. For example, the “n” and “u” on the right in Fig. 2b have different widths. A full unit’s difference in width for these two characters on an eighteen-unit system would be too much, so both characters are designed to the same width, as shown in Fig. 2c. The aesthetic quality of the mechanical compositors is very good, even with these restrictions.

The IBM SELECTRIC Composer is still a typewriter, in the sense that the keyboard is a typewriter keyboard and the printing mechanism is that of a typewriter, but it is also a composer, in that it approaches the proportionality (Fig. 2d), and hence the aesthetic quality, of the modern mechan-

Figure 3 Unit relationships of classical type styles.

Photocomposer Fonts																								Mechanical Composer Fonts																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40							
	BASKER. ROM.	BASKER. ITAL.	BODONI ROM.	BODONI ITAL.	BODONI SEMIB.	BODONI BOLD	GARAMOND ROM.	GARAMOND ITAL.	CASLON ROM.	CASLON ITAL.	CASLON BOLD	JANSON ROM.	JANSON ITAL.	JANSON BOLD	MERIDIEN ROM.	MERIDIEN ITAL.	MERIDIEN SEMIB.	MERIDIEN BOLD	UNIVERS 47	UNIVERS 57	UNIVERS 67	UNIVERS 45	UNIVERS 55	UNIVERS 65	BEMBO ROM. 270	BEMBO ITAL. 270	BEMBO BOLD 428	CENTAUR RO. 252	CENTAUR IT. 252	ROCKWELL RO. 371	ROCKWELL B. 391	GILL ROM. 262	GILL ITAL. 262	GILL BOLD 275	PERPETUA R. 239	PERPETUA I. 239	CLARENDON R. 12	TIMES ROM. 327	TIMES ITAL. 327	TIMES BOLD 334	TOTAL	AVERAGE					
a	8.5	8.0	8.0	9.0	8.5	8.5	7.0	7.5	8.0	8.0	8.5	7.5	8.0	8.5	8.5	8.0	8.5	9.5	8.5	9.0	9.0	8.5	8.5	9.0	8.0	8.0	9.0	7.0	7.0	9.0	10.0	8.0	8.0	10.0	7.0	8.0	9.0	9.0	9.0	9.0	336.50	8.41					
b	10.0	7.5	9.0	8.5	9.5	9.5	8.0	6.5	9.5	7.5	9.5	9.0	7.5	9.0	9.0	7.5	10.0	11.0	9.0	9.0	9.5	9.0	9.0	9.5	10.0	8.0	11.0	9.0	7.0	11.0	11.0	10.0	10.0	11.0	9.0	8.0	9.0	10.0	9.0	9.0	9.0	365.00	9.12				
c	7.5	6.0	7.5	7.0	7.5	8.0	6.5	5.0	7.5	6.0	7.5	7.0	5.5	7.5	7.5	6.0	8.0	8.5	8.5	8.0	8.5	8.0	8.0	8.5	8.0	6.0	9.0	7.0	5.0	9.0	10.0	8.0	8.0	9.0	8.0	6.0	8.0	9.0	8.0	8.0	8.0	301.50	7.53				
d	10.0	9.0	9.0	9.5	9.5	9.5	8.5	8.0	9.5	8.0	10.0	9.0	8.0	9.5	9.5	7.5	10.0	11.0	9.0	9.0	9.5	9.0	9.0	9.5	10.0	8.0	11.0	9.0	7.0	11.0	11.0	10.0	10.0	11.0	9.0	8.0	9.0	10.0	9.0	9.0	9.0	372.00	9.30				
e	8.0	6.5	8.0	7.5	8.0	8.5	6.5	5.0	8.0	6.0	8.0	7.5	6.0	8.0	8.0	6.0	8.0	9.5	8.5	8.5	9.0	8.5	8.5	9.0	8.0	7.0	9.0	7.0	5.0	10.0	10.0	9.0	9.0	10.0	8.0	6.0	8.0	8.0	8.0	8.0	8.0	315.00	7.87				
f	5.5	5.0	5.0	5.5	5.5	5.5	5.0	5.0	5.5	5.5	6.0	5.0	4.5	5.5	5.0	4.5	5.5	6.5	5.5	6.0	6.0	4.5	5.0	5.5	5.0	6.0	5.0	7.0	6.0	5.0	5.0	6.0	5.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0	6.0	218.00	5.45				
g	9.0	7.5	8.5	8.5	9.0	9.5	8.0	6.0	9.0	7.0	9.5	8.5	7.5	8.5	8.5	7.5	9.0	9.5	9.0	9.0	9.5	9.0	9.0	9.5	10.0	8.0	11.0	8.0	6.0	11.0	11.0	9.0	9.0	10.0	8.0	8.0	9.0	9.0	9.0	9.0	9.0	350.50	8.76				
h	10.0	8.0	9.0	9.0	9.5	9.5	8.0	8.0	10.0	8.0	10.0	9.0	8.5	9.5	10.0	8.5	11.0	12.0	9.0	9.0	9.5	9.0	9.0	9.5	10.0	9.0	11.0	9.0	7.0	10.0	11.0	10.0	10.0	11.0	9.0	8.0	10.0	10.0	9.0	9.0	9.0	375.50	9.38				
i	5.0	4.5	4.5	5.0	5.0	5.0	4.0	4.5	5.0	5.0	5.0	4.5	4.5	5.0	5.0	4.0	5.0	6.0	4.0	4.5	4.5	4.0	4.0	4.5	5.0	5.0	6.0	5.0	5.0	5.0	6.0	5.0	5.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	195.00	4.87				
j	5.0	4.5	4.5	4.5	5.0	5.5	4.0	4.5	5.0	4.5	5.0	4.0	4.5	4.5	4.5	4.5	4.0	5.0	6.0	4.0	4.5	4.5	4.0	4.0	4.5	5.0	5.0	6.0	5.0	5.0	5.0	6.0	5.0	5.0	6.0	5.0	6.0	5.0	5.0	5.0	5.0	198.00	4.95				
k	9.0	7.5	8.5	8.5	9.5	10.0	8.0	7.5	9.0	7.5	9.5	8.5	7.0	9.0	9.5	8.0	10.0	11.0	8.0	8.5	9.0	7.5	8.0	9.0	10.0	9.0	11.0	9.0	6.0	10.0	11.0	10.0	10.0	11.0	9.0	7.0	10.0	10.0	10.0	10.0	10.0	360.50	9.01				
l	5.0	4.5	4.5	5.0	5.0	5.0	4.0	4.5	5.0	4.5	5.0	4.5	4.0	5.0	5.0	4.0	5.0	6.0	4.0	4.5	4.5	4.0	4.0	4.5	5.0	5.0	6.0	5.0	5.0	5.0	6.0	5.0	5.0	6.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	194.00	4.85				
m	15.0	12.0	14.0	13.0	14.0	14.0	12.0	11.0	14.0	11.5	14.0	14.0	14.0	14.0	15.0	13.0	16.0	17.0	14.0	14.0	15.0	14.0	14.0	15.0	16.0	13.0	18.0	14.0	11.0	15.0	18.0	15.0	15.0	18.0	14.0	11.0	15.0	15.0	14.0	14.0	14.0	569.50	14.23				
n	10.0	8.5	9.0	9.0	9.5	9.5	8.0	7.5	9.5	8.5	10.0	9.0	9.0	9.5	10.0	8.5	11.0	12.0	9.0	9.0	9.5	9.0	9.0	9.5	10.0	9.0	11.0	9.0	8.0	10.0	11.0	10.0	10.0	11.0	9.0	8.0	10.0	10.0	9.0	9.0	9.0	377.00	9.42				
o	10.0	7.0	8.5	8.0	9.0	9.5	8.0	6.5	9.5	6.5	10.0	9.0	7.0	9.5	9.0	7.0	9.5	10.5	9.0	9.0	9.5	9.0	9.0	9.5	10.0	8.0	11.0	8.0	6.0	10.0	10.0	10.0	10.0	11.0	9.0	7.0	9.0	10.0	9.0	9.0	9.0	356.00	8.90				
p	10.5	8.5	9.0	9.0	9.5	9.5	8.0	6.5	9.5	7.5	10.0	9.0	8.0	9.5	9.5	7.5	10.0	11.0	9.0	9.0	9.5	9.0	9.0	9.5	10.0	9.0	11.0	9.0	7.0	11.0	11.0	10.0	10.0	11.0	9.0	8.0	9.0	10.0	9.0	9.0	9.0	370.00	9.25				
q	10.0	7.5	9.0	8.5	9.5	9.5	8.0	7.0	9.5	8.0	9.5	9.0	8.0	9.0	9.5	7.5	9.5	10.5	9.0	9.0	9.5	9.0	9.0	9.5	10.0	8.0	11.0	9.0	6.0	11.0	11.0	10.0	10.0	11.0	9.0	8.0	9.0	10.0	9.0	9.0	9.0	365.00	9.12				
r	7.0	6.0	7.0	7.0	7.5	8.0	5.5	5.5	6.5	6.5	7.0	6.0	7.0	6.5	6.5	6.5	7.0	8.0	5.5	6.0	6.5	5.5	5.5	6.0	7.0	6.0	8.0	6.0	6.0	8.0	8.0	8.0	8.0	8.0	9.0	7.0	6.0	7.0	7.0	7.0	7.0	271.00	6.71				
s	6.5	5.5	7.0	7.0	7.5	7.5	5.5	4.5	6.5	5.5	7.0	6.0	5.0	6.5	6.5	5.5	7.0	7.5	8.0	8.0	8.0	7.5	7.5	8.0	6.0	6.0	7.0	6.0	5.0	8.0	9.0	7.0	7.0	8.0	6.0	5.0	7.0	7.0	7.0	7.0	268.00	6.70					
t	5.5	5.0	6.0	5.5	6.0	6.5	5.0	4.5	5.5	5.0	6.0	5.5	5.0	6.0	5.5	4.5	5.5	7.0	5.5	6.0	6.0	5.0	5.5	6.0	6.0	5.0	7.0	6.0	5.0	5.0	6.0	7.0	8.0	6.0	5.0	6.0	6.0	7.0	6.0	231.50	5.78						
u	10.0	9.0	9.0	9.0	9.5	9.5	7.5	7.5	9.5	8.0	10.0	9.0	9.0	9.5	9.5	8.5	10.0	11.0	9.0	9.0	9.5	9.0	9.0	9.5	10.0	9.0	11.0	9.0	8.0	10.0	11.0	10.0	10.0	11.0	9.0	8.0	10.0	10.0	9.0	9.0	9.0	374.00	9.35				
v	8.0	8.5	8.0	8.0	8.0	9.0	8.0	6.5	8.0	8.5	8.5	8.0	8.0	8.0	9.0	7.5	9.0	10.5	7.5	8.0	8.5	7.0	8.0	8.5	10.0	9.0	11.0	8.0	7.0	10.0	11.0	9.0	9.0	10.0	8.0	7.0	9.0	9.0	8.0	8.0	8.0	339.50	8.48				
w	12.0	11.5	11.5	12.5	12.0	13.0	12.0	9.5	12.5	11.5	12.5	13.0	12.0	12.5	14.0	11.0	14.0	16.0	12.5	13.0	14.0	12.0	13.0	14.0	15.0	13.0	16.0	12.0	11.0	14.0	15.0	14.0	14.0	15.0	13.0	10.0	13.0	13.0	12.0	12.0	513.50	12.83					
x	9.0	8.0	8.0	10.0	8.5	9.0	7.5	7.5	8.5	8.5	9.0	7.5	8.0	7.5	9.0	8.0	9.5	10.0	6.5	7.5	8.5	7.0	7.5	8.5	10.0	10.0	11.0	8.0	9.0	10.0	10.0	10.0	10.0	11.0	9.0	7.0	9.0	9.0	10.0	10.0	351.50	8.78					
y	8.0	6.5	8.0	9.0	8.5	8.5	8.0	6.0	8.5	6.5	9.0	8.5	7.0	8.5	8.5	7.5	9.0	10.0	7.5	8.0	8.5	7.0	8.0	8.5	10.0	9.0	11.0	8.0	7.0	10.0	11.0	9.0	9.0	10.0	8.0	7.0	9.0	9.0	9.0	9.0	340.00	8.20					
z	6.5	7.0	7.5	8.0	8.0	8.0	6.5	6.5	8.0	8.5	8.0	7.0	7.5	7.5	7.0	6.5	7.5	8.0	6.0	6.5	7.5	6.5	7.0	7.5	8.0	10.0	10.0	8.0	8.0	8.0	9.0	8.0	8.0	10.0	7.0	7.0	8.0	8.0	8.0	8.0	307.50	7.68					

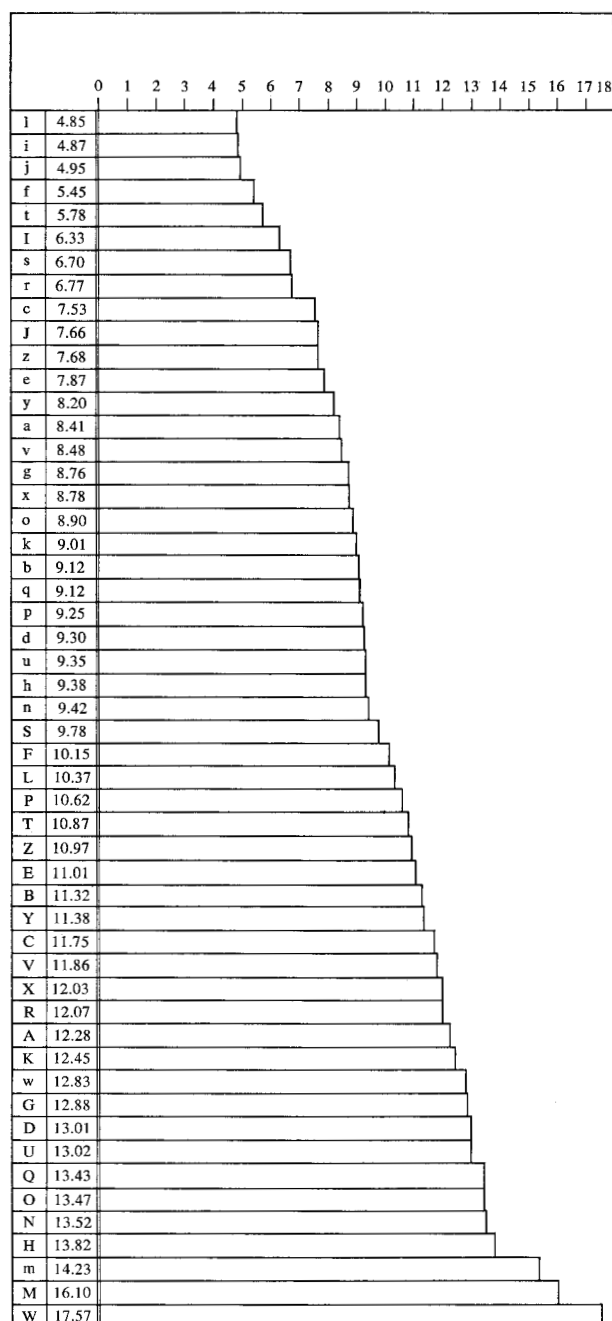


Figure 4 Scale of character unit averages.

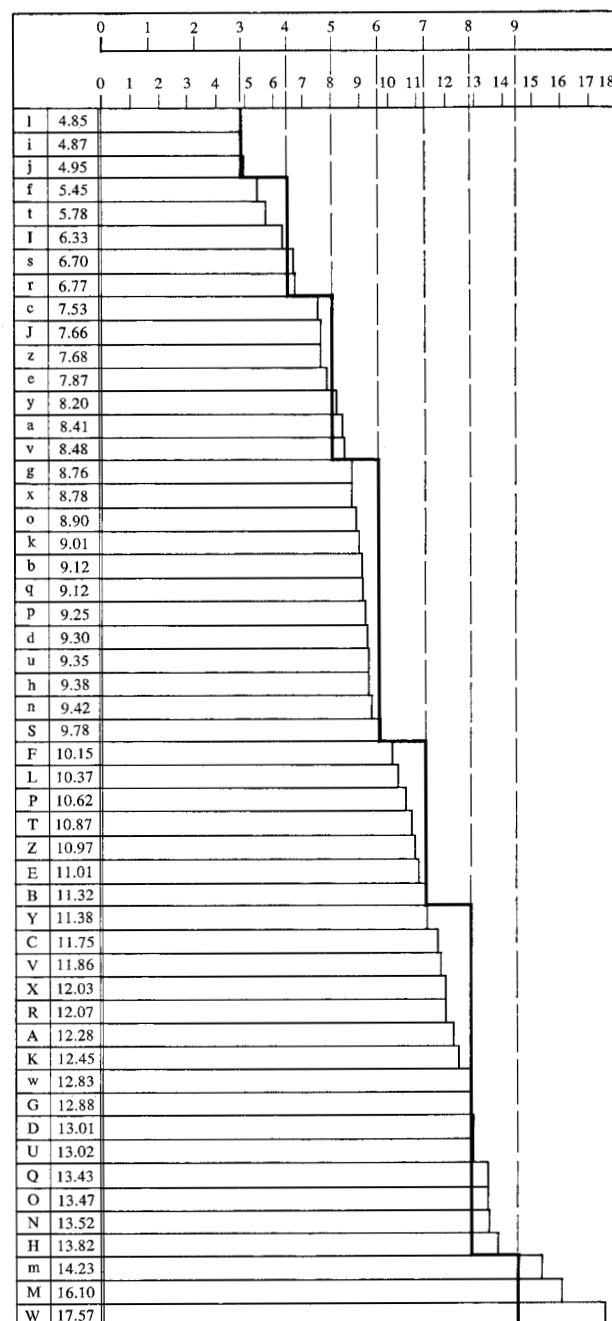


Figure 5 Superposition of the nine-unit system.

ical composer. The process remains under the direct control of the author, however, and thus the concept of the "modern calligrapher" is appropriate.

Typographic uniqueness of the IBM SELECTRIC Composer

The unit system devised for the IBM SELECTRIC Composer is a nine-unit system, or one-half that of most present-day

photocomposers and mechanical compositors. What is the effect of this unit system on the character forms?

Forty classical type fonts (including fonts designed for both photocomposers and mechanical compositors using eighteen-unit systems) were used to determine the average unit assigned to each character in the alphabet (Fig. 3). Only the lower case alphabet is shown but the upper case alphabet was similarly treated.

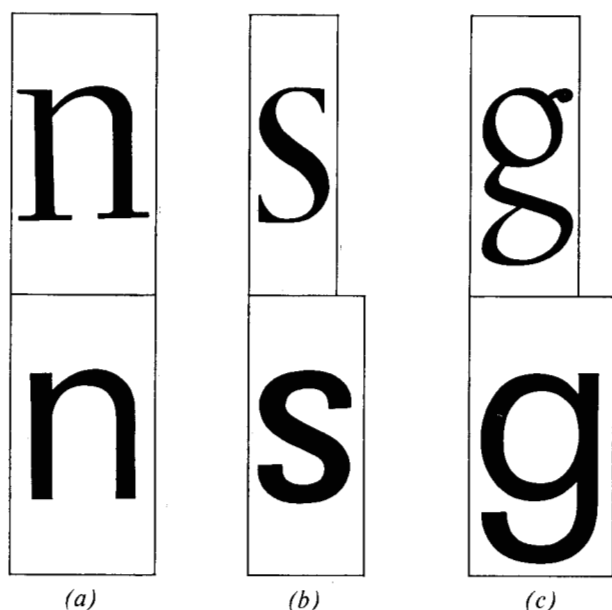


Figure 6 Unit requirements for characters of different styles.

A graphical representation of the character width averages, given in increasing order, generates the scale shown in Fig. 4. At the top of the scale is the lower case "l" with an average width of 4.85 units. At the bottom of the scale is the upper case "W" with an average width of 17.57 units.

In Fig. 5 a nine-unit scale is superimposed on the eighteen-unit scale shown in Figure 4, and the groupings of characters within the nine-unit system are shown by means of a bar graph. Minimum distortions of the characters are necessary in order to condense the unit system by one-half.

Problems of typographic quality are not created by the fact that the unit system has been reduced by one-half, but rather by the fact that each character, regardless of style or weight, has always to be designed to a certain width (within the nine-unit system). For 95% of the characters this does not create a problem. For example, in Fig. 6a, the lower case "n" is shown designed both in old style type and a sans serif type. The width requirement is the same for both. However, the lower case "s" designed in an old style type requires less width than in a sans serif type. The closed endings in the sans serif lower case "s" require much more volume and width (Fig. 6b). The lower case "g" is similar in its width requirements (Fig. 6c).

In addition, unique width requirements also exist between old style and its italic form; e.g., the italic form of the lower case "v" is wider than the old style "v" (Fig. 7a). To compound the problem, the old style "o" is wider than its italic form (Figure 7b).

For the type designer, other typographic quality problems also exist due to the uniqueness of the impact printing mechanism of the IBM SELECTRIC Composer. When designing type for a photocomposer, the type designer has to

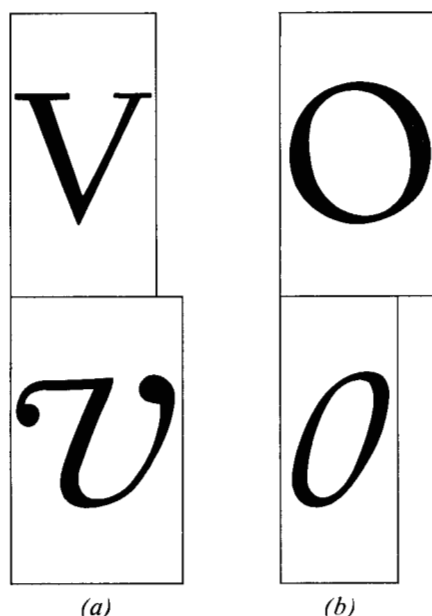
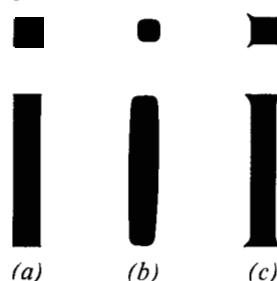


Figure 7 Differences in the effect of the italic style on unit requirements.

Figure 8 Relationship of character forms required for photo-composition: (a) desired form; (b) process-induced distortion; (c) designer's compensation.



compensate for a rounding of the character edges created by the characteristics of the photographic process being used. Figures 8a, 8b, and 8c, show (respectively) the form of an "i" desired, the form of that "i" distorted by a photographic process, and the form of an "i" designed to compensate for the distortion in order to obtain the desired "i" as an output.

With the IBM SELECTRIC Composer the opposite happens; characters of small size tend to spread on the paper, due to the characteristics of the impact printing device, while characters of large size may be difficult to print without small voids and edge distortion. To cope with this problem, the printing mechanism is designed to impart three different velocities to the printing element. The characters are divided into three groups, depending on the velocity required to generate uniform character weight on the printed page. The type designer may recognize minute differences within these groupings and compensate for these differences in the

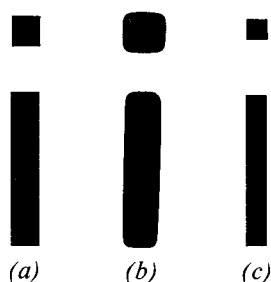


Figure 9 Relationship of character forms required for the IBM SELECTRIC Composer: (a) desired form; (b) process-induced distortion; (c) designer's compensation.

design of the width and shape of the character. For example, the lower case "i" may be designed proportionately lighter than other characters in the same velocity grouping. Figures 9a, 9b, and 9c, show (respectively) the desired form of an "i", the spreading of that "i" on the printed page, and the "i" designed to compensate for the spreading in order to achieve the desired width on the printed page.

Conclusions

The improved technique of composing made possible with the IBM SELECTRIC Composer is an example of how engineers and type designers working closely together can achieve a common objective. As the examples above have shown, the efforts of either of these groups individually might have introduced serious compromises in the end result desired by the typographer; however, the coordinated efforts of these two groups enhanced the introduction of an entirely new device for composition.

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